

Global Essay Competition 2025

Title: From Qubits to Crops: A quantum framework for agricultural equity.

Essay:

Introduction

"Global Village" is a famous term coined by Canadian media theorist Marshall McLuhan in the 1960s, which highlights the emergence of powerful communication technologies that provided great opportunities in global trade and optimization of the world's resources.

As today's world is accelerating rapidly towards creating an intelligence that can solve problems that plagued humanity for ages, the term 'Global Village' begins to make more and more sense. In this context, it becomes prudent to comprehend that the plethora of opportunities that arise out of technology also brings a range of challenges to address.

In this essay, the focus is specific to an emerging technology that probably might change the way we look at the world—the quantum computer. The prospects of quantum computer-based agriculture, and a strategy for mitigation of risks of divide between nations due to this technology, form the crux of this essay.

While the fact that quantum computing has unlimited potential to completely transform various aspects of life on this planet is undeniable, such power in the wrong hands will be devastating. Reaching a common ground built on the foundations of sustainability, ethics, and accessibility, achieved through international collaboration, becomes the prerequisite for application of quantum computing to alleviate suffering.

Quantum Computing: A catalyst for Global Power Shifts

With the rat race among world powers like the USA, China, and the EU to develop the most advanced AI models and the buzz around Google's Willow quantum chip, which can perform a computation in under 5 minutes that would take 10 septillion years by today's fastest supercomputers ¹, it is clear that the world as we know it is going to change. For beginners, quantum computing is a technology that eliminates the restriction of computation to just '0' and '1' by introducing 'QUBITS' which can wobble between multiple states, are correlated, and are entangled ². This exceptional computational ability offers great opportunities in various fields, like pharmaceutical research – modelling complex protein foldings, cutting years off of drug development ³, Material discovery—simulating complex molecular dynamics of specialized materials ⁴, and many more.

Given the range of opportunities quantum computing has to offer, nations worldwide are in a race to harness its power. In an Ethiopian world, every human shares these resources and strives toward creating a beautiful planet. On the contrary, it is certain that nations that emerge victorious out of this metaphoric 'Quantum Tunnel' will witness a tremendous power shift in their favour and will try to keep it for themselves. An example is the restrictions set by the USA on NVIDIA and AMD, two US-based computational chip makers for AI, stopping the export of their highly advanced chips to China ⁵, thereby hindering its attempts to create advanced AI models.

While the list of sectors that will witness power shifts due to this technology is endless, let's focus on one critical sector—agriculture.

Agriculture: A high-stakes game

The world population crossed 8 billion in 2022, and the United Nations predicts the population to grow to 9.7 billion by 2050. More than half of the growth in global population is predicted to occur in the African subcontinent ⁶. Despite progress, the World Health Organization reported that 1 out of 11 people globally has faced chronic hunger in 2023. The report clearly highlights the severe food shortage to more than 2.33 billion people worldwide ⁷. A heartbreaking fact is that malnutrition causes nearly half of all deaths in children under the age of five ¹⁰. Hunger and poverty are intertwined, and the higher the food shortage, the higher the poverty level ¹¹.

Food insecurity impacts communities as a whole. Consider the example of the 'Horn of Africa'—Somalia, Ethiopia, and Kenya. The region has experienced prolonged severe droughts, and the situations were further exacerbated by climate change, which ultimately resulted in large-scale livestock deaths and migration of communities ¹². Another example is South Sudan, which experiences a combination of political instability, conflict, climate change, and economic challenges—all of which have led to chronic food insecurity. The UNICEF, in a briefing note¹³ on nutrition in South Sudan, predicted that 1.4 million children suffer from malnutrition in 2021.

Although the contribution of agriculture directly to world GDP is only around 4% in 2023 ⁸, considering the related industries like food processing, transportation, and retail, its impact is much bigger. All these figures stress the criticality of this sector.

As grim as the picture might be, artificial intelligence coupled with quantum computing has the ability to alleviate this turmoil and create food security for everyone on the planet. From sickles and plows to IoT and AI, agriculture has advanced significantly. Modern farms are now equipped with IoT sensors in the soil that generate data on various soil parameters, like moisture, fertilization level, and more; drones fly over the farms that take pictures of the crops and use image recognition models to identify areas of concern. The other types of data associated with modern farms include meteorological data and agronomic data ⁹, which are continuously interpreted and acted upon by the AI systems. Despite the advent of IoT long ago, many farmers worldwide still suffer from lack of guidance, inaccurate climate predictions, and uncertain data about the soil, mainly due to the lack of enough processing power to handle staggering number of variables involved in agriculture.

Enter quantum computing and AI; they have the potential to solve all the above-mentioned problems by increasing manifold the utility of IoT sensors and climatology data. While today's AI can process the farm sensor data and satellite imagery, quantum computers have the ability to analyse millions of different variables together and provide astonishingly accurate predictions. Another major impact is the ease of creation of new and advanced varieties of crops with needed traits like disease resistance, higher yield, etc through genetic modification. What may take generations to develop through selection and breeding can be done in days with the extensive simulation capacity of quantum computers ¹⁴.

While it is clear that quantum computing and AI are going to become the cornerstones for farming in near future, the imbalance such power can create is strikingly significant. Those with access to the power of quantum can make significant strides in agriculture, while those without it will lag behind, struggling with unpredictable crops and a changing climate, leading to escalating food poverty.

International Collaboration—A Ray of Hope

Irrespective of the caste, creed, religion, and nationality, we are all humans first, and humanity perpetually faces a common enemy—hunger. In the words of Mahatma Gandhi, "**The world has enough for everyone's need, but not enough for everyone's greed.**" Given the groundbreaking advancements in technology, it is high time that humanity came together to combat hunger and emerge victorious through international collaboration and sharing of resources.

In order to address this burning problem, I propose a framework of two international bodies:

1. Formation of a global alliance – International Agriculture and Food Security Confederation (IAFSC),
2. Establishment of an International Quantum Exchange for Agriculture (IQEA) where quantum computational power is exchanged between nations.

IAFSC

Mission:

- a. To guide and mentor the world's nations in achieving a hunger-free world,
- b. To provide a framework and act as a regulatory body for the International Quantum Exchange,
- c. To work actively towards the creation of sustainable quantum computing practices in agriculture across the globe,
- d. To act as a central repository of knowledge and a hub for strategic planning and resource mobilization, and
- e. To set up philanthropic standards to promote availability of computational power to poorer nations.

Members:

- a. Various first, second, and third world countries (represented by government agencies responsible for agriculture, science, and technology),
- b. International Organizations (like FAO, WHO, WTO, etc.),
- c. Academic Institutions (the forerunners of research on quantum computing-based agriculture),
- d. Private Sector (Companies pioneering Quantum Computing and AI),
- e. NGOs

Functions:

- a. Regulating the IQEA (International Quantum Exchange for Agriculture)
- b. Valuating the Quantum Power,
- c. Aiding the nations participating in the exchange with technical know-how and strategy.

This establishment occurs in three phases:

Phase-1 (6 months): Nations come together through an International Agriculture Summit and establish the Confederation involving the members as detailed above.

Phase-2 (12 months): The governing body of the confederation works closely with all the member bodies to research and create a standardized metric of quantum power (to be called the QPU – Quantum Power Unit) and methods to valueate it.

Phase-3 (12 months): The Confederation establishes the exchange (IQEA) where nations in need of quantum computational abilities can purchase it from other nations pioneering and possessing it.

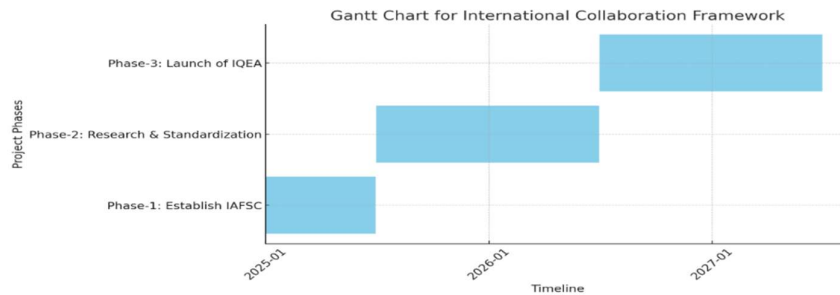


Figure-1: Grantt chart for the phase wise implementation of the proposed framework starting from January 2025 (Source: Generated by ChatGPT)

IQEA

The IQEA acts as a single-stop destination for nations to access quantum computational power only for agricultural purposes.

1. It works as a centralized digital platform where transactions are tracked and verified using blockchain technology.
2. The currency utilized for the exchange would be the *USD* because of its strength and relevance in the current global scenario.
3. Strict compliance measures like peer reviews and potential sanctions for non-compliance will be established for misuse of quantum computational power.
4. A centralized dispute resolution framework, presided over by **IAFSC**, will be set up to resolve international conflicts in the exchange.
5. Clear policies will be implemented through **IAFSC** for protection of IP rights of quantum algorithms and agricultural applications.
6. The usage will be tracked and billed on the basis of the standardized metric, i.e., the QPUs used.

The following are the potential benefits of such a framework:

- Democratization of access to quantum computational power—countries that do not have research capabilities to develop their own computational capacities can obtain the same at a price.
- Transparency and accountability—the usage of computational resources can be tracked, and the users can be made accountable for misuse.
- Centralized valuation of quantum power through **IAFSC**—fair valuation of quantum power based on world economic factors.
- Expert inputs through IAFSC to participating nations—imparting practical knowledge to implement and utilize the quantum agricultural models most efficiently.

The “economic performance and food shortage-based differential pricing mechanism” is a key feature of this exchange. In short, the poor countries with low GDP values and high food shortages will have access to this quantum computational power at much cheaper prices than the nations that are well-off. The **IAFSC** will regulate this from a philanthropic perspective.

The tiered pricing can be structured as follows:

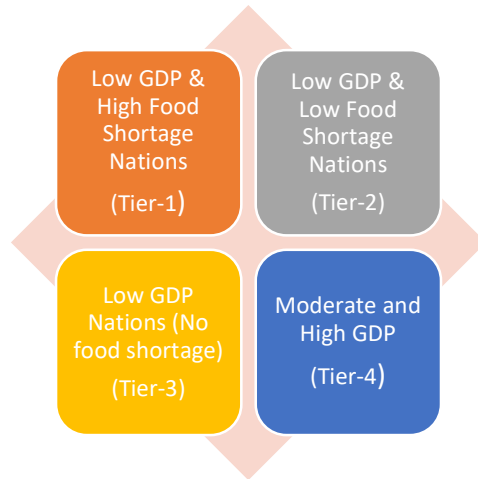


Figure-2: Framework of the proposed differential pricing method

The QPU prices will be lowest for Tier-1 nations, increasing gradually for Tier-2, 3, and 4 nations in that order.

Challenges

The IAFSC-IQEA framework needs to overcome various challenges in order to be successful in its mission to alleviate hunger in the world.

The first challenge is to ensure that countries with quantum computational power participate. This is the key hurdle, which can only be solved by genuine international collaboration. The International Agriculture Summit would be the crucial element in this issue. By conducting various surveys that bring out raw turmoil in the countries suffering, involving various farmer groups, and presenting how quantum computing can change the world, an appeal can be made to the humanity of the participating nations of the summit to collaborate and establish this framework. Introduction of – **Philanthropic Participation Index (PPI)**, which measures a nation’s efforts of doing good to the world, and PPI-linked trade agreements would further incentivize nations to actively take part in the proposed framework.

Second is the research and investment required to establish the standardized metric, the QPU. Given the dynamic nature of quantum computing and ever-changing and ever-progressing technology, it becomes extremely difficult to establish and value a standard metric for measuring quantum computational power. The IAFSC plays a crucial role here. A scientific advisory board will be set up in the confederation consisting of experts from academic institutions and the private sector to benchmark the quantum technology and come up with required standards.

Conclusion: Is the world really a global village?

Quantum computing and AI have the power to make the borders in the world more porous or more fortified, depending upon who is wielding it. To avoid the creation of a world where some nations enjoy food surplus and exert economic dominance and some others grapple with hunger, innovative solutions like the IAFSC-IQEA framework, based upon international collaboration and ethical consideration, become crucial. Only upon creating a world where resources essential for sustenance of humankind across the planet shall be shared freely regardless of borders, the world becomes a ‘Global Village’ in its true sense.

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